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Super Fine-Grained Detector for the T2K long-baseline neutrino experiment

The Tokai-to-Kamioka (T2K) experiment is a long-baseline neutrino experiment sited in Japan. T2K obtained results that disfavor the CP conservation with a 90% confidence level so far. The (anti)neutrino beam created at the J-PARC is characterized at the near detector before measuring neutrino oscillation parameters by the Super-Kamionde detector at 296 km away. Toward more precise measurements of neutrino oscillations, T2K experiment started operation of the fully upgraded near detector in 2024 to further reduce major systematic errors on the neutrino-nucleus interaction. An upstream part of the near detector complex, ND280, was replaced with three detectors: the Super Fine-Grained Detector (SuperFGD), two High-Angle Time Projection Chambers (HATs), and six Time of Flight detectors (ToFs). SuperFGD is a target tracker which consists of about two million 1 cm^3 plastic scintillator cubes packed in about 2 m x 2 m x 0.6 m dimension. Scintillation light from the cube is read out by about 56 thousand channels from three directions through wavelength-shifting fibers and photo sensors. It provides 3D track reconstruction, 4 π angular acceptance, calorimetry, and detection capability of neutrons and low energy protons. We report SuperFGD design, construction, operation status and detector performance.

Secondary track

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